SUPERFUND RESPONSE ACTION PRIORITY PANEL REVIEW FORM

Date Form Completed: October 16, 2015

General Site Information

Region:	8	City:	Helena	State:	Montana
CERCLIS EPA ID:	MTD982572562	CERCLIS Site Name:	Crystal Mine OU5/Basin NPL Site		
NPL Status: (P/F/D)	F	Year Listed to NPL:	1999		

Brief Site Description: *(Site Type, Current and Future Land Use, General Site Contaminant and Media Info, Site Area and Location information.)*

The Basin Mining District NPL site is located in and around the unincorporated town of Basin in Jefferson County, Montana. The NPL site encompasses about 77 square miles and includes the town of Basin and about 300 individual abandoned mine sites in the surrounding watersheds of Basin Creek, Cataract Creek and the upper Boulder River. The Crystal Mine OU5 is remotely located at an elevation of around 8,000 feet in the Cataract Creek watershed, and acidic mine drainage (AMD) from the Crystal impacts Uncle Sam Gulch (USG) Creek, a tributary of Cataract Creek.

In 2001, the EPA began a remedial investigation/feasibility study (RI/FS) of the Basin Watershed OU2 in which the Crystal Mine was included. The RI/FS was published in 2005 and concluded that water quality degradation in Cataract Creek during low-flow months was predominantly attributable to the tributaries—in particular, USG Creek. The results exceeded both ecological and human health benchmarks for arsenic, cadmium, copper, lead and zinc.

Because the AMD from the Crystal is one of the largest contributing sources of water quality degradation in the Cataract Creek watershed, EPA decided to prioritize it for response action by developing an interim ROD. The final ROD for the Basin Watershed OU2 will incorporate the interim ROD for the Crystal.

Two NTCRAs have been performed at the Crystal. The first occurred in 2002, and involved the filling in of a long surface trench that had been mined historically. EPA believed that would reduce the adit discharge flow rate. Unfortunately the flow rate was reduced by only approximately 25%. The second NTCRA was performed in 2014 and involved the successful removal of two sediment retention ponds that were left on site from a historic (1994-1996) remote mine site demonstration project. The ponds had filled with AMD and sludges and were about to fail and discharge the contamination onto the USFS land below. (See Exhibit 1-4 at the end of this form).

In addition to contaminated surface water and sediment in USG Creek, the Crystal contains about 85,000 cubic yards of contaminated waste rock that covers over 40 acres, about 22 of which are disturbed from mining activities. The site is accessible for 5 months each year, from June through October via unpaved secondary roads maintained by the USFS. Snowmobilers may access the site during the winter months.

General Project Information

Type of Action:	Remedial	Site Charging SSID:	08ER
Operable Unit:	5	CERCLIS Action RAT Code:	RA-3

Is this the final action for the site that will result in a site construction completion?	Yes	X No
Will implementation of this action result in the Environmental Indicator for Human Exposure being brought under control?	X Yes	No

Response Action Summary

Describe briefly site activities conducted in the past or currently underway:

As noted above, two NTCRAs have been performed (2002, 2014). In addition, the site was the subject of a remote mine site demonstration project (1994-1996) which involved the testing of a lime treatment plant to treat the AMD. The remote location led to problems with iron plugging and other issues, and EPA concluded that lime treatment would not be successful at this location. EPA conducted the RI/FS between 2010 and 2013, and issued the Proposed Plan in March of 2014. EPA also performed a Treatability Study in 2014 during which the AMD was treated using 3 different media for a passive treatment system sulfate reducing bioreactor. The interim ROD was signed in April of 2015.
Specifically identify the discrete activities and site areas to be considered by this panel evaluation:
The Interim ROD calls for the removal of approximately 85,000 cubic yards of contaminated waste rock to an onsite repository that will be constructed near the eastern end of the historic trench. The ROD also calls for construction of stormwater control features to minimize infiltration of precipitation into the mine workings. And finally, the ROD calls for the construction of a passive treatment system (PTS) to treat the AMD from the lower adit portal. The activities will need to be constructed over several years due to the short (5 month) construction season. The first phase will involve road improvement and waste rock repository construction. The second phase will involve moving waste rock to the repository and reconstruction of USG Creek. The final phase will involve the final design and construction of the PTS. The final design phase of the PTS cannot be performed until the new topography of the site can be surveyed after the waste rock has been removed. Revegetation of the site will follow construction activities. The last steps of the remedy will be monitoring and maintenance of the PTS, the repository, and stormwater flow control features.
Briefly describe additional work remaining at the site for construction completion after completion of discrete activities being ranked:
EPA will need to carefully monitor the performance of the PTS for several years to optimize its performance. When the ROD for the Basin Watershed OU2 is finalized, EPA will need to decide if the interim remedy is fully functional and operational, and if the interim remedy should become part of the final remedy for OU2.
<u>Response Action Cost</u>
Total Cost of Proposed Response Action: *($ amount should represent total funding need for new RA funding from national allowance above and beyond those funds anticipated to be utilized through special accounts or State Superfund Contracts.)*
$19 Million ($11M soils/waste rock removal and repository construction, stormwater controls, and creek remedial action + $8M PTS)
Source of Proposed Response Action Cost Amount: *(ROD, 30%, 60%, 90% RD, Contract Bid, USACE estimate, etc…)*
100% design for the access/haul road improvement, water drainage improvements, waste rock repository construction, contaminated soil and waste rock removal, reclamation of 1,000 ft of Uncle Sam Gulch Creek; and 30% design for the PTS.
Breakout of Total Action Cost Planned Annual Need by Fiscal Year: *(If the estimated cost of the response action exceeds $10 million, please provide multiple funding scenarios for fiscal year needs; general planned annual need scenario, maximum funding scenario, and minimum funding scenario.)*
The first year will involve road improvement, construction of stormwater control features, and construction of the waste rock repository. These costs are estimated at $6 million. The second year will involve waste rock removal and placement in the repository, and stream rehabilitation on USG Creek. The costs of the second year activities is estimated at $6 million. The third year will involve final design of the PTS, and construction of the PTS. The cost of third year activities is estimated at $7 million.

Other information or assumptions associated with cost estimates?
Currently, the PTS design is at 30% because the topography of the areas of the site that will be used for construction of the PTS system is unknown. A large volume of contaminated soils and waste rock must first be removed from these areas before the PTS system design can be fully completed. Therefore, the PTS system costs are less certain. The nearby Bullion Mine site (OU6) is also being considered for remedy funding. If both sites are undergoing construction simultaneously, it is likely there will be cost savings due to integration and coordination of activities at both sites as envisioned by the Integrated Cleanup Initiative (ICI, 2012). For example, mobilization costs for large equipment can be "shared" as can construction oversight by project manager and/or professional engineer. EPA has been using the ICI approach with these two sites throughout the RI/FS, ROD, and RD phases, and there will be several additional opportunities to minimize costs by implementing remedies at these two sites during the same years.
Readiness Criteria
1. Date State Superfund Contract or State Cooperative Agreement will be signed (Month)?
March 2016
2. If Non-Time Critical, is State cost sharing (provide details)?
Yes, details to be worked out in the SSC.
3. If Remedial Action, when will Remedial Design be 95% complete?
RD for the repository, stormwater control features, and road work will be 100% complete by the end of calendar year 2015. RD for the PTS will be 100% complete by the end of March, 2017.
4. When will Region be able to obligate money to the site?
March 1, 2016
5. Estimate when on-site construction activities will begin:
June of 2016, as soon as the site is snow free and accessible.
6. Has CERCLIS been updated to consistently reflect project cost/readiness information?
Yes – needs update to reflect current design cost estimate.

Site/Project Name:	**Basin Mining District, Crystal Mine Site OU5**

Criteria #1 - RISKS TO HUMAN POPULATION EXPOSED (Weight Factor = 5)
Describe the exposure scenario(s) driving the risk and remedy. Include risk and exposure information on current/future use, on-site/off-site, media, exposure route, and receptors:
Contaminants in soil and seeps/springs represent a threat to human health. The primary risk to human health from exposure to arsenic documented in the HHRA was for exposure of adolescent and adult recreational users (primarily to potential ATV users) to soils at the Site, although the levels at the Site would also pose a risk to residential or commercial users. Current use of the site is recreational, and exposure to contaminated soil occurs primarily via inhalation of dust during ATV use and wind events. Additionally, arsenic and cadmium levels emanating from seeps/springs contains levels high enough to pose an unacceptable risk to recreational users that could use these as sources of drinking water. Furthermore, the Boulder River is the drinking water source for the town of Boulder, MT. Contaminated water from the site enters USG Creek which flows into Cataract Creek, which flows into the Boulder River slightly upstream of the town of Boulder.

Estimate the number of people reasonably anticipated to be exposed in the absence of any future EPA action for each medium for the following time frames:

MEDIUM	<2yrs	<10yrs	>10yrs
Soil/Mine Waste	50-60	400-600	1,500+
Surface Water	25-40	200-250	500+
Ground Water	NA	NA	NA

Discuss the likelihood that the above exposures will occur:

Uncle Sam Gulch Creek is a tributary to Cataract Creek. Private property along Cataract Creek is supporting more residential use each year as recreational cabins are being built. This contributes to steady use of the Crystal Mine site. Each year the site is visited by recreational users, including children, on ATVs during the summer months. No controls exist at the site to prevent exposures to contaminated soil and AMD water. Barren soils, rock dumps and suitable access make these areas attractive to 4-wheelers and other ATV use. With the Deer Lodge National Forest surrounding the mine claims, this is also a popular area for hunters and campers.

Other Risk/Exposure Information?

Contamination from waste rock and soils at the site can be spread by wind, intense rain events/associated erosion, and vehicle tires that come into contact with these soils. Other risks include residents from private property along Cataract Creek and nearby town of Basin using the exposed waste rock and soils for fill and driveways.

Site/Project Name:	**Basin Mining District, Crystal Mine OU5**

Criteria #2 – SITE/CONTAMINANT STABILITY (Weight Factor = 5)

Describe the means/likelihood that contamination could impact other areas/media given current containment:

Contamination of surface water from AMD from the adit portal, and from contaminated soils which erode and leach into USG Creek, is ongoing. The average flow rate from the adit is about 25 gpm with pH around 4. Metals loading to USG Creek is significant (Cu 1.81; As 0.078; Cd 0.168; Zn 12.97; Pb 0.015 lbs/day). Soil contamination also contributes to water qualtiy degradation (As 42,648; Cu 3,626; Pb 8,563; Zn 3,122 mg/kg). Soils at the Site are very unstable, and erode freely into USG Creek. Macroinvertebrate density is robust upgradient of the Site (600 organisms/square meter), but declines to near zero below the site.

Are the contaminants contained in engineered structure(s) that currently prevents migration of contaminants? Is this structure sound and likely to maintain its integrity?

No, there is zero containment of site contaminants.

Are the contaminants in a physical form that limits the potential to migrate from the site? Is this physical condition reversible or permanent?

Contaminants are not limited physically from migrating from the site.

Are there institutional physical controls that currently prevent exposure to contamination? How reliable is it estimated to be?

There are no institutional controls at the site.

Other information on site/contaminant stability?

In addition to the contaminants being mobile through surface water and soil transport, contaminants can also become mobilized through manmade actions such as excavations and transportation. The site can be accessed during the summer and there are no institutional controls in place to prevent the public from taking soil from the site and using it as fill material in the town of Basin.

Site/Project Name: **Basin Mining District, Crystal Mine OU5**

Criteria #3 – CONTAMINANT CHARACTERISTICS (Weight Factor = 3)
(Concentration, toxicity, and volume or area contaminated above health based levels)

List Principle Contaminants (Please provide average and high concentrations.):
(Provide upper end concentration (e.g. 95% upper confidence level for the mean, as is used in a risk assessment, or maximum value [assuming it is not a true outlier], along with a measure of how values are distributed {e.g. standard deviation} or a central tendency values [e.g., average].)

Contaminant	*Media	**Concentrations			
		Maximum	Minimum	Mean	95% UCL
As (mg/kg)	SL	41,100	10	2,441	3,685
Cd (mg/kg)		144	1.6	25.5	33.36
Pb (mg/kg)		8,563	12.4	1,175	1,629
		Maximum	Minimum	Mean	
As (mg/l)	SW	0.315	0.037	0.122	
Cd (mg/l)		0.737	0.331	0.559	
Pb (mg/l)		0.073	0.007	0.037	
		Maximum	Minimum	Mean	
Sb (mg/kg)	ST	65.3	22.4	37.5	
As (mg/kg)		3,830	783	1,889	
Cd (mg/kg)		71.6	21.2	39.4	
Cu (mg/kg)		755	113	534	
Pb (mg/kg)		2,110	603	1,073	
Ag (mg/kg)		12.4	3.6	7.08	
Zn (mg/kg)		1,360	281	1,047	

*(*Media: AR – Air, SL – Soil, ST – Sediment, GW – Groundwater, SW – Surface Water)*
*(**Concentrations: Provide concentration measure used in the risk assessment and Record of Decision as the basis for the remedy.)*

Describe the characteristics of the contaminant with regards to its inherent toxicity and the significance of the concentrations and amount of the contaminant to site risk. *(Please include the clean up level of the contaminants discussed.)*

Contaminants in soil and seeps/springs represent a threat to human health. The primary risk to human health from exposure to arsenic documented in the HHRA was for exposure of adolescent and adult recreational users (primarily to potential ATV users) to soils at the site, although the levels at the site would also pose a risk to residential or commercial users. The cleanup level for arsenic (1,243 mg/kg) is based on potential risks (including bioavailability testing) derived for the adolescent recreational user. Additionally, arsenic levels emanating from seeps/springs contains levels high enough to pose an unacceptable risk to recreational users that could use these as sources of drinking water. The removal of contaminated soil to attain the cleanup level for arsenic will reduce other soil contaminants such as cadmium, copper, lead and zinc.

The ERA indicates unacceptable risks to fish and benthic organisms exposed to USG Creek and Cataract Creek surface water and sediment. Levels of several COCs in USG Creek surface water exceed Montana water quality standards and surface water toxicity tests show significant fish mortality. Levels of several COCs in USG Creek sediments exceed benchmarks and population surveys indicate reduced abundance and diversity of benthic macroinvertebrates. The ERA also indicates levels of several COCs (primarily in soil and sediment) pose unacceptable risks to plants, birds and mammals.

EPA has concluded that the remedial actions selected in this interim ROD are necessary to protect human health and the environment from actual or threatened releases of hazardous contaminants. Because this is an interim action, the EPA has waived the surface and ground water quality standards until a final action is taken for the Basin Watershed OU2. The goal of the final action for OU2 will be to meet all ARARs, including DEQ-7 standards for surface water and ground water.

Cleanup levels were not established for aquatic receptors exposed to sediments because it was determined that sediment contamination will be addressed by reducing the source of sediments (through mine water treatment and contaminated waste rock, soil, and sediment removal within the mine boundaries) and natural recovery induced by runoff action in the channel. The progression of natural recovery will be monitored at a downstream point of compliance along USG Creek beyond the Site boundaries (approximately one-half mile below the Mammoth Mine Claim boundary).

Describe any additional information on contaminant concentrations which could provide a better context for the distribution, amount, and/or extent of site contamination. *(e.g. frequency of detection/outlier concentrations, exposure point concentrations, maximum or average concentration values, etc.....)*

Contamination at the site is well documented in the RI. The highest values are at the twin ore bins associated with the upper adit, and the ore load out structure located at the lower adit. Because the soils on at least 22 acres of the site are contaminated and unvegetated, and highly erosive, contaminants are mobilized during storm events and impacts to USG Creek are ongoing. Furthermore, the AMD from the lower adit portal continuously impacts USG Creek with high concentrations of heavy metals and arsenic, and low pH.

In the past, soil from the site was imported into the town of Basin and used as fill for driveways and yards. The town of Basin was remediated in 2002-2004. EPA has provided fact sheets on the dangers of mining contaminated soil to the residents of Basin. However, there is no institutional control in place that would prevent an individual from taking soil from the site and placing it in town.

Other information on contaminant characteristics?

Site/Project Name:	Basin Mining District, Crystal Mine Site OU5

Criteria #4 – THREAT TO SIGNIFICANT ENVIRONMENT (Weight Factor = 3)

(Endangered species or their critical habitats, sensitive environmental areas.)

Describe any observed or predicted adverse impacts on ecological receptors including their ecological significance, the likelihood of impacts occurring, and the estimated size of impacted area:

Risks posed to species that may use the 22 acre site were determined for mammalian and avian receptors. Exposure was assumed to occur through contact with soil, sediment and surface water collectively. COPECs resulting in LOAEL-based ecological HQs exceeding 1 are as follows:

- Deer mouse—aluminum, antimony, arsenic, cadmium, copper, lead, selenium
- Mule deer—arsenic
- Raccoon—aluminum, antimony, arsenic
- Northern goshawk – arsenic, lead
- Dusky flycatcher—arsenic, cadmium, copper, lead, zinc
- Spruce Grouse – lead

No unacceptable risks to threatened or endangered species were identified because they are not expected to frequent the site. The site condition (barren and rocky, little vegetation) discourages use by those species.

Would natural recovery occur if no action was taken? Yes X No
If yes, estimate how long this would take.

Metals concentrations in soils associated with disturbed areas of the site create phytotoxic conditions preventing plant growth. This condition coupled with the friable nature of the soils creates an erosion prone environment contributing to a sustained lack of nature recovery.

Other information on threat to significant environment?

Studies performed in Cataract Creek (downstream of Uncle Sam Gulch Creek tributary) show a profound adverse impact on local fisheries. Uncle Sam Gulch Creek is barren of fish and benthic macroinvertebrates below the Crystal Mine discharge to its confluence with Cataract Creek (approx. 2 miles). This is direct evidence of the sustained toxic nature of the mine discharge. Metals loading to the creek was cited in Criteria #2.

Site/Project Name:	Basin Mining District, Crystal Mine Site OU5

Criteria #5 – PROGRAMMATIC CONSIDERATIONS (Weight Factor = 4)

(Innovative technologies, state/community acceptance, environmental justice, redevelopment, construction completion, economic redevelopment.)

Describe the degree to which the community accepts the response action.

EPA held a public meeting on March 19, 2014 at the Basin School to explain the preferred remedy and the ROD process to the community and solicit their comments. Comments verbalized at this meeting were generally supportive of the proposed clean-up plan. A transcript of the meeting was placed in the Administrative Record for the Site. No written comments were received during the public comment period.

Describe the degree to which the State accepts the response action.

The State signed the interim ROD for the Crystal site on March 20, 2015. The State has concerns with the O&M requirements for the PTS, but the design of the PTS will minimize O&M to the extent practical.
Describe other programmatic considerations, e.g.; natural resource damage claim pending, Brownfields site, use of innovative technology, construction completion, economic redevelopment, environmental justice, etc…
There are no natural resource damage claims pending, and the remote location of the site does not provide much opportunity for Brownfields or economic redevelopment. There are no EJ issues, the site is a privately owned mine claim. Innovative technology that will be utilized at the site includes gravity flow systems for the PTS, and utilization of a unique media (sugar cane bagasse) in the PTS. EPA performed a Treatability Study using sugar cane bagasse in 2014 and found that it provided better results than the typical/traditional sulfate reducing bioreactor media. EPA's contractor, CH2MHILL, was working on mine sites in Peru when they came across a locally grown material that showed a lot of promise for treating AMD. Sugar cane bagasse is the byproduct of sugar cane after the sugar has been taken out of it. Additional research at the University of Colorado (Boulder) using sugar cane bagasse showed promise even at low pH levels and low temperatures. For the Treatability Study at the Crystal, sugar cane bagasse from Louisiana was used. The bagasse is very permeable and acts as an electron-donor (carbon) source to create anaerobic conditions and promote biological reduction--by sulfate-reducing bacteria –converting sulfate in the AMD to sulfide. Dissolved heavy metals in the AMD influent combine with these sulfides to settle out or adhere to the fibers as insoluble meta-sulfide solids, leaving the effluent water much cleaner. The Treatability Study and a laboratory bench test conducted in 2015 showed that contaminants are reduced by 97 to 99%. This may result in meeting WQS at the site boundary, even though those standards were waived until the Basin Watershed OU2 ROD.

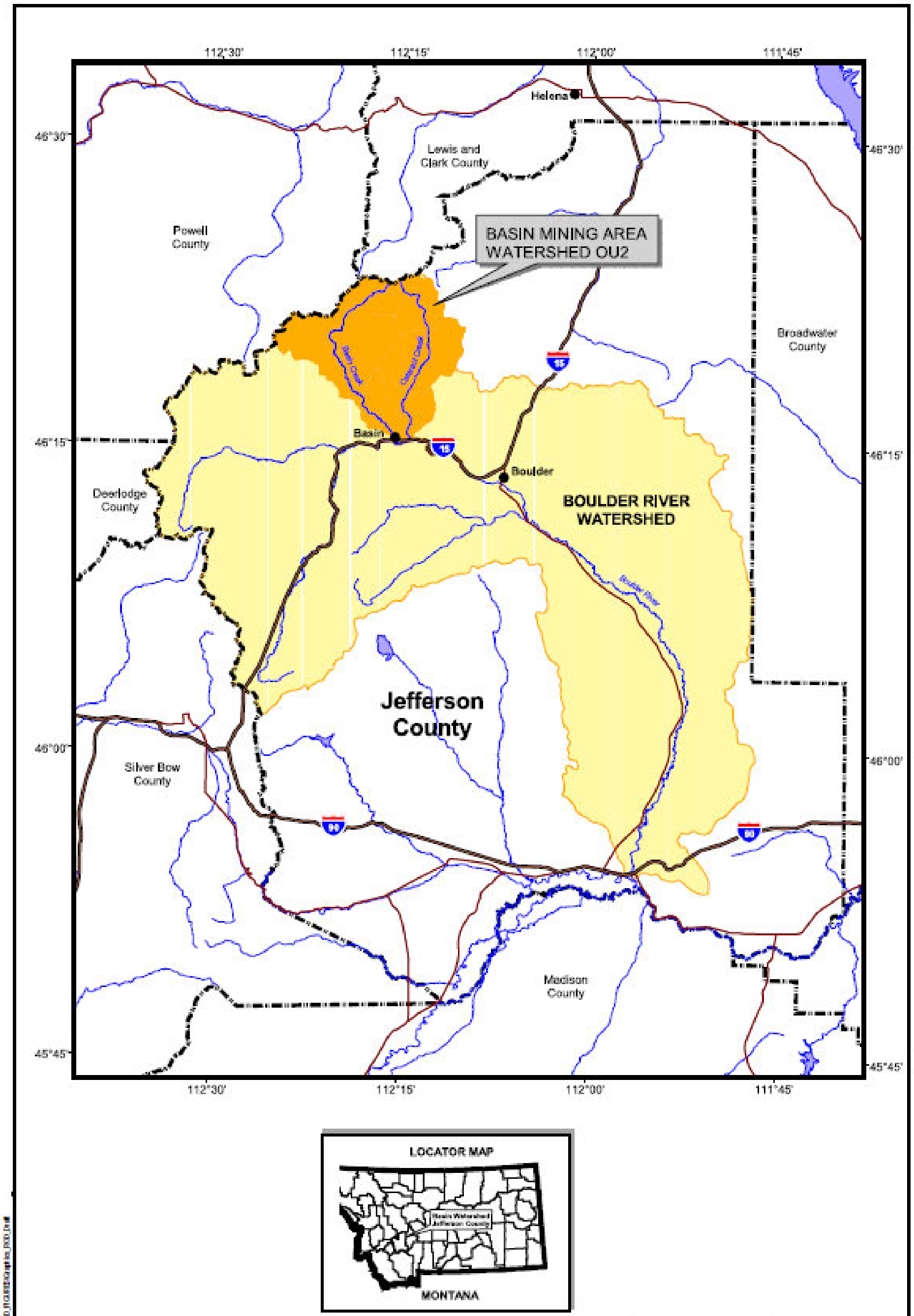

Exhibit 1-2

Basin Watershed OU2 Relative to Boulder River Watershed

BASIN WATERSHED OPERABLE UNIT 2
JEFFERSON COUNTY, MONTANA
Crystal Mine OU5 ROD

Source: Draft RI for Basin Watershed OU2 (CDM 2005b)
Crystal Mine OU5 Remedial Investigation

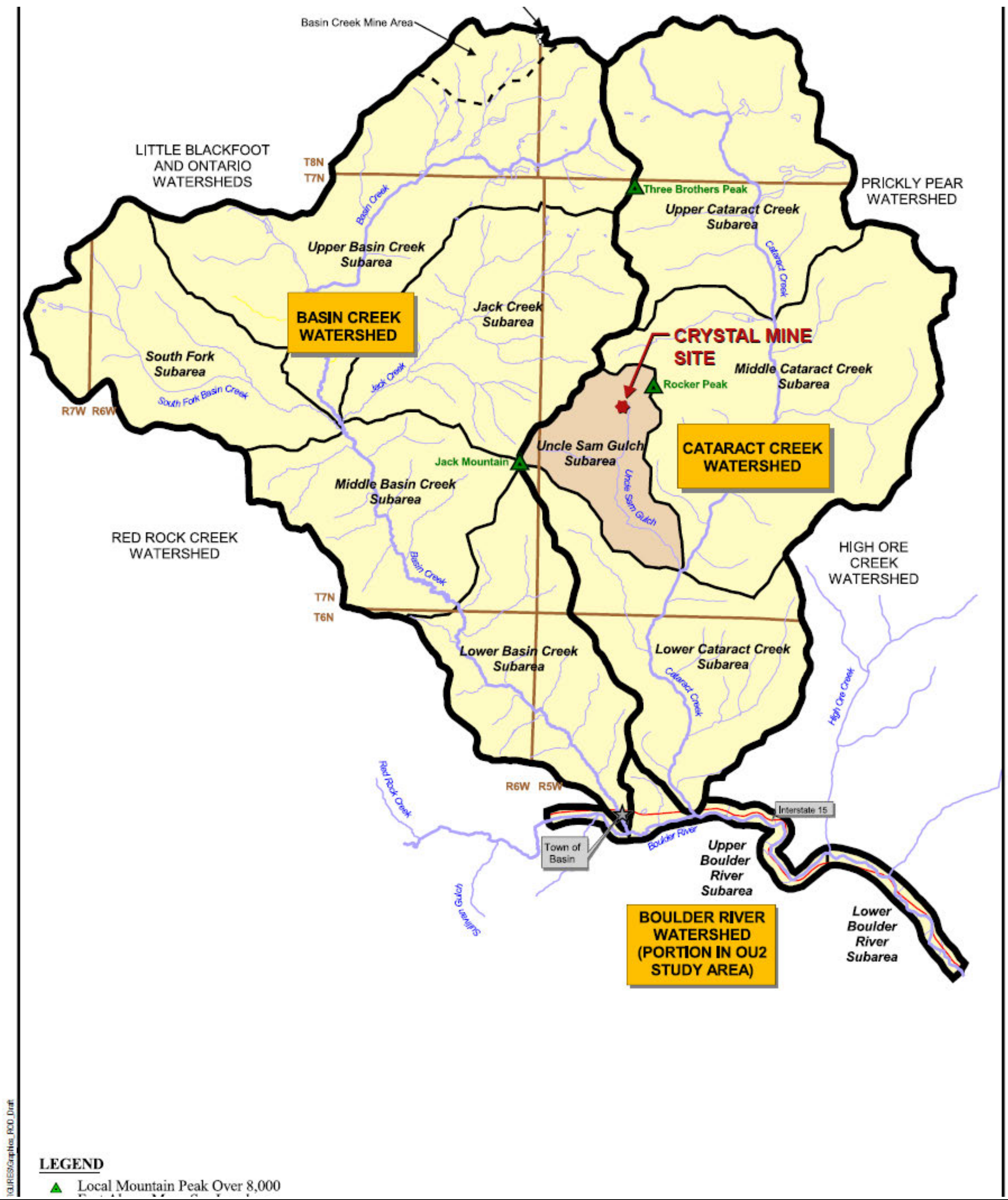
Basin Creek Mine Area
LITTLE BLACKFOOT AND ONTARIO WATERSHEDS
T8N
T7N
Three Brothers Peak
PRICKLY PEAR WATERSHED
Upper Cataract Creek Subarea
Upper Basin Creek Subarea
BASIN CREEK WATERSHED
Jack Creek Subarea
CRYSTAL MINE SITE
South Fork Subarea
Middle Cataract Creek Subarea
Rocker Peak
R7W R6W
South Fork Basin Creek
Jack Creek
Basin Creek
Cataract Creek
Uncle Sam Gulch Subarea
CATARACT CREEK WATERSHED
Jack Mountain
Middle Basin Creek Subarea
Uncle Sam Gulch
RED ROCK CREEK WATERSHED
HIGH ORE CREEK WATERSHED
T7N
T6N
Lower Basin Creek Subarea
Lower Cataract Creek Subarea
High Ore Creek
Red Rock Creek
R6W R5W
Interstate 15
Town of Basin
Boulder River
Upper Boulder River Subarea
Sullivan Gulch
BOULDER RIVER WATERSHED (PORTION IN OU2 STUDY AREA)
Lower Boulder River Subarea
LEGEND
Local Mountain Peak Over 8,000

EXHIBIT 1-4
Crystal Mine Site
Crystal Mine OU5 ROD